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Hints and tips on solving obscure problems in radio repair

References to the different chapters are from *Modern Radio Servicing* by Alfred A. Ghirardi, B.S, E.E. , This chapter XXIII has help a lot collectors with obscure receiver troubles. Even if you possess this book, printing this chapter here will save wear on the book.

OBSCURE RECEIVER TROUBLES NOT REVEALED BY SET ANALYZERS

23-1. Obscure Troubles in Receivers.—Possibly the most perplexing troubles encountered in radio service work are those which do not manifest themselves by abnormal currents, voltages, or resistances and hence are not located by the usual current-voltage or resistance-analysis of the receiver. The analyzer readings may all be normal, all the tubes may test within acceptable tolerances—and yet the receiver may operate poorly, intermittently, or not at all. Cases of this kind are most common in superheterodyne receivers, because many troubles and misadjustments may exist even though the tubes, voltages and parts are in normal condition. The hunting down of these obscure troubles often taxes the resourcefulness and ingenuity of the service man and calls forth from him every bit of radio knowledge and experience he possesses. It is the purpose of this chapter to point out some of the causes, and, what is even more important, remedies for common receiver troubles that are not usually revealed by the ordinary voltage, current, or resistance analysis of the receiver.

In Chapter XVIII, some preliminary tests were explained, which may be made to localize the trouble to a particular portion of the receiver. These preliminary tests should be made in all cases. However, for the purposes of radio servicing, the receiver should not be considered as a complete unit, but rather as being composed of a number of main correlated parts. Since each main part of a radio receiver may develop certain individual troubles that are characteristic of that part, it is logical that we should treat and discuss each one of these troubles separately

One important point should be kept clearly in mind throughout this chapter. For instance, an open-circuited primary winding or plate impedance, such as the resistance or choke coil of an r-f or i-f transformer, can be revealed by lack of plate voltage in that stage. An open-circuited secondary coil will often manifest itself by zero grid bias and an increase in the plate current of that stage, etc. These causes of trouble will undoubtedly be revealed quickly by the set analyzer and a point-to-point test, so we are not interested in them here. However, other more obscure troubles, which the set analyzer would not reveal, might cause the same symptoms. These are the types of troubles in which we are interested in this chapter. This point will not be mentioned again, but it should be kept clearly in mind throughout the entire chapter. We shall call these "obscure" troubles, since their causes are not readily apparent and they are not easily located.

23-2. Obscure Troubles in R-F and I-F Amplifiers.—The main trouble symptoms which may result from "obscure" troubles in radio-frequency and intermediate-frequency amplifiers are:

1. Lack of sensitivity.
2. Oscillation or regeneration.
3. Station interference.
4. Double-spot tuning.
5. Code interference.
6. Hum.
7. Fading.
8. Intermittent reception.
9. Distortion.
10. Noisy reception.

These will now be considered in detail in the above order.

23-3. Lack of Sensitivity Caused by Coupling Coil or Condenser.—Lack of receiver sensitivity, resulting in weak signals, is often due to some failure in the coupling arrangement employed to transfer energy from one r-f stage to the next. To illustrate this point, let us consider the r-f amplifier stage circuit at (*A*) of Fig. 23-1. In this case L_1 is a high-impedance plate choke constructed so that its resonance point occurs at some frequency near the low-frequency end of the broadcast band. It may be located some distance from tuning coil L_2, as the transference of energy does not depend entirely upon inductive

coupling between L_1 and L_2. The coupling between the plate circuit of one tube and grid circuit of the next is mainly *capacitive*, and is obtained by the capacity action between the grid coil L_2 and the "coupling winding" (which consists of a few turns of wire placed near L_2), or by means of a low-capacity coupling condenser, C_c, as shown at (*B*) of Fig. 23-1. An open-circuit in the lead connecting the "coupling coil" to the plate of the tube, or an open-circuited coupling condenser C_c, causes the set to be

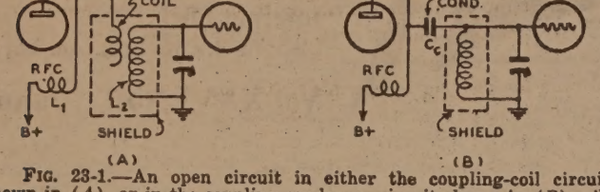

FIG. 23-1.—An open circuit in either the coupling-coil circuit shown in (*A*), or in the coupling-condenser circuit shown in (*B*) will cause lack of sensitivity in an r-f or i-f amplifier which employ them. These obscure troubles would not be revealed by the usual voltage-current analysis of the receiver.

insensitive, and weak reception results—or the set fails to operate altogether. If the insulation between the coupling coil and L_2 becomes faulty, leakage (or a short-circuit) will take place between them, resulting in "noise", or even complete inoperation. The faulty insulation should be replaced.

An open circuit in either the coupling coil or coupling condenser cannot be disclosed by a voltage-current test with a set analyzer. A point-to-point resistance check may reveal the open coupling coil. However, these parts may be placed under suspicion by the action of the receiver. A study of their function in the receiver will show why they may cause lack of sensitivity. The primary L_1 is usually a universal-wound coil placed inside and close to one end of the secondary, L_2. Transfer of energy takes place from L_1 to L_2 inductively, mostly at the low-frequency end of the tuning band only. Near the high-frequency end, the current actually flowing through the coil is small compared to that through the distributed capacity of the coil (it is usually tuned by means of its distributed capacity to about 600 meters in a broadcast receiver), so that the amount of energy transfer is small. The additional coupling coil is placed as shown at (*A*) or a small amount of capacity is added, as shown at (*B*), in order to bring up the high-frequency response. Therefore, if a receiver operates well over the low-frequency end of the scale, but the response falls off *gradually* as it is tuned to a higher and higher frequency, any coupling arrangements such as these should be suspected if they are employed. The receiver response may be tested by feeding a signal of constant strength to it by means of a test oscillator, and measuring the receiver output by means of an output meter while the tuning of both the test oscillator and receiver are varied, in step, over the entire broadcast range.

23-4. Lack of Sensitivity Caused by Mis-alignment.—Lack of normal sensitivity in a t-r-f receiver may also be due to mis-alignment of its tuning circuits. Although the methods

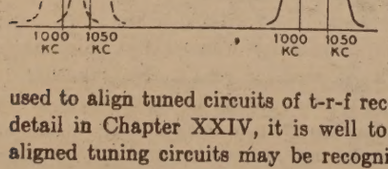

FIG. 23-2. — Resonance curves illustrating how "double-hump" response, *C*, will occur due to mis-alignment of the tuning circuits whose individual resonance curves are *A* and *B* respectively.

used to align tuned circuits of t-r-f receivers will be discussed in detail in Chapter XXIV, it is well to point out here how mis-aligned tuning circuits may be recognized by certain symptoms of the receiver. If the tuned circuits of a t-r-f receiver are not aligned properly, the receiver will be insensitive because all the individual tuned circuits will not be tuned to the same common frequency at all settings of the tuning dial. This results in weak signals and "double-hump" tuning.

The form of double-hump tuning to be described here is not the same as that encountered with superheterodyne receivers, though it may occur in both types. If one tuned circuit is tuned to 1,000 kc and another to, say, 1,050 kc, the combination of the two resonant frequencies will give rise to a type of response not characteristic of t-r-f receivers. Thus, suppose response curve *A* of Fig. 23-2 is that of circuit No. 1, and curve *B* that of circuit No. 2. The overall response of the tuning system will be that shown by curve *C*. If the two peaks are 50 kc apart, then the tuning system will respond to a range of frequencies at least 50 kc wide. When tuning a t-r-f receiver with mis-aligned circuits, the response will be weak and the tuning broad; furthermore, there will be two distinct points, close together, at which definite resonant peaks can be noted. These points correspond to the individual peaks shown in the figure. If the misalignment of the tuning circuits is caused by the gang tuning condensers, the receiver should be realigned in accordance with the information presented in Chapter XXIV.

A change in coil inductance, caused by the absorption of moisture or the shifting of the turns of wire of which the coils are composed, can also cause misalignment of the tuning circuits, with the resulting broad tuning and insensitiveness. Modern receiver manufacturers take precautions to prevent the absorption of moisture or the slipping of turns, but they often occur nevertheless. In some instances, when the shift in inductance is slight, it may be compensated for by a readjustment of the trimmer condenser, but, when the shift is fairly large, a new coil must be used. Attempts to compensate for appreciable inductance shift by capacity readjustment almost always results in misalignment at frequencies other than the one at which the realignment was made.

23-5. Use of Tuning Wand for Checking Alignment.—If a gang-tuned receiver has symptoms of broad tuning and abnormally low sensitivity, it is natural to suspect that one or more of its r-f tuning stages are mis-aligned (of course it is assumed that a tube check and analyzer test has revealed no other troubles). Before making any r-f, oscillator, or first-detector adjustments, the accuracy of the existing adjustments should be checked. This can be done quickly without disturbing the adjustment of the trimmer condensers, by means of a simple little tool called a *tuning wand*, provided the receiver construction is such that it is possible to insert a tuning wand through an opening in the shield of the tuning coil (if shields are employed) so that it may be inserted into the coil-form proper. The receiver should be tuned either to the signal from a broadcasting station, or a signal should be fed to it by a test oscillator and its output measured by a suitable output indicator when this is done.

The tuning wand, Fig. 23-3, consists of a bakelite rod having a *brass* cylinder at one end and a special finely-divided *iron* core insert at the other end. Inserting the *brass* cylinder into the center of a tuning coil *lowers* its inductance because of the reaction of the eddy currents induced in the brass. Inserting the *iron* end *increases* its inductance because of the high permeability of the iron. From this it is evident that before adjusting the trimmer condensers on the main gang tuning condenser, the adjustment may be checked by inserting each end of the wand into the coil. If insertion of the brass end *increases* the receiver output, the tuning capacity must be *reduced*. If insertion of the

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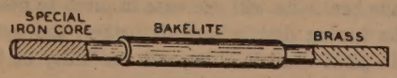


FIG. 23-3.—A "tuning wand" which may be used to determine whether a tuned stage is properly aligned with others in the same amplifier.

iron end *increases* the output, the tuning capacity must be *increased*. From this it is evident that unless the trimmer adjustment for a particular coil is perfect at alignment frequencies, inserting one end of the wand may increase the output of a particular signal. A perfect adjustment is evidenced by a *lowering* of the output when *either end* of the wand is inserted into the coil. In this way each of the tuned stages may be checked for alignment. If the receiver is found to be out of alignment, adjustments should be made, as explained in Chapters XXIV and XXV, to make the receiver output maximum. If it is badly out of alignment, the coils should be examined for short-circuited turns, slipped turns, or discoloration due to the absorption of moisture.

23-6. Lack of Sensitivity in Superheterodyne Receivers.—Insensitivity of superheterodyne receivers may be divided into two general types: that originating in the r-f and oscillator portions of the receiver, and that confined to the i-f amplifier section. Insensitivity is characterized in superheterodynes by weak signals and excessive tube noise, not by broad tuning. As is well known, the i-f amplifier in a superheterodyne is tuned to some fixed frequency, which is always the difference between the signal frequency and that of the oscillator. If the alignment of the oscillator stage becomes shifted in some way, the oscillator frequency changes, which changes the "difference frequency," or i-f produced. This "difference frequency" will not be the same as the frequency to which the i-f stages are fixed-tuned. Therefore, the amplification produced by the i-f amplifier is greatly reduced. A change in coil inductance caused by the absorption of moisture or shifting of the turns of wire (see Page 605) is often responsible for this mis-alignment of the oscillator stage. Regardless of the degree of selectivity of the r-f amplifier preceding the first detector, the *sharpness of tuning* remains, although other forms of interference may be experienced.

The alignment of the oscillator stage may be checked easily through the use of a calibrated r-f test oscillator producing an unmodulated signal. A small pickup coil (of 5 or 10 turns), which fits over the first-detector tube is employed to couple the test oscillator to the receiver. Before switching on the test oscillator, tune the receiver to the correct, or known, frequency of some broadcast station operating on about 1,100 or 1,200 kilocycles. If the receiver uses a separate oscillator tube, it should be removed. Now adjust the test oscillator to produce a signal frequency which is *higher* than the frequency to which the receiver is tuned by an amount equal to the frequency of the i-f amplifier. In other words, if the receiver is tuned to a 1,200 kc broadcast station, and a 260 kc i-f amplifier is employed in the receiver, then the test oscillator should be adjusted to 1,460 kc. The broadcast station should now be heard if the receiver is in operating condition, since the test oscillator signal will beat with the station carrier to produce the intermediate frequency. It is assumed that the dial calibration of the receiver is correct. Should satisfactory operation be obtained in this manner, and the receiver fail to operate satisfactorily when connected in the normal way, then the oscillator circuit in the receiver is at fault.

Once the oscillator has been adjusted, the r-f circuits may be checked by means of the tuning wand described in Art. 23-5. The alignment of the i-f amplifier, however, cannot be checked unless a test oscillator and an output indicator are available, as will be explained in Art. 25-13 of Chapter XXV.

Poor sensitivity in superheterodyne receivers may also be found to be caused by poor, or "flat," oscillator tubes which operate at certain frequencies and not at others, although they test satisfactorily in a tube checker. The type '36 tube employed in superheterodyne receivers as a combination first detector and oscillator is a frequent offender of this type and is a source of much annoyance. It may oscillate only over certain frequencies, sometimes at both ends of the broadcast band and sometimes at either the low or high-frequency end. This condition may be remedied by reducing the value of the cathode bias resistor so as to increase the plate current. Usually, however, merely changing the oscillator tube is sufficient.

An excellent manner by which obscure troubles in the r-f stages of superheterodyne receivers may be localized is as follows. Disconnect the oscillator voltage by removing the oscillator tube or short-circuiting the oscillator tuning condenser. Place a pair of headphones in place of the primary of the first i-f transformer and tune the receiver for signals.* The signals should have fair strength because the mixer tube is usually a good detector (except in the pentagrid converter tubes, which are only fair detectors); the r-f circuits should now be lined up. The oscillator tube should then be placed in operation and the phones connected in the plate circuit of the second detector; the oscillator and r-f circuits may then be adjusted. In this manner, troubles in the r-f end of the receiver may be discovered and corrected, without the complications usually added by the oscillator and i-f amplifier.

23-7. Lack of Sensitivity Caused by Faulty Connections.—There are several causes of insensitivity common among t-r-f and superheterodyne receivers which are not usually revealed by an ordinary receiver analysis. These causes are usually most difficult to find, and therefore require the most time to locate.

A high-resistance joint in the primary or secondary of tuned circuits will result in low sensitivity. A high-resistance joint is usually caused by faulty soldering, and, though it may have little effect on the voltage readings, may offer considerable resistance to the radio *signals*. The best method of determining whether such a condition exists, is by means of an ohmmeter used as a point-to-point tester. Difficulties of this nature are also often associated with the fact that reception is obtained over only a part of the tuning range, usually the low-frequency section. To illustrate how obscure a trouble of this kind may be, mention may be made of a case in which a superheterodyne receiver was serviced. The set received stations below 860 kc at low volume, but no reception was obtained at all above 860 kc. The usual set analysis disclosed all operating voltages to be normal and beyond suspicion. However, a careful resistance check brought to light a high-resistance connection between the choke in an r-f plate circuit and the lead connected to the small, double-turn coupling coil placed at one end of the secondary. The resistance of this connection was about 1,000 ohms—enough to impair the sensitivity of the receiver.

*NOTE: If a crystal detector is connected in series with the earphones, the oscillator tube need not be removed. This unit may then be used for checking the signal at any stage of either the r-f or i-f amplifier.

High resistance joints cannot always be located by mere visual inspection or ohmmeter tests. The degree of contact, and resistance of the joint, may depend upon the temperature of the receiver—the joint may have a high resistance only when the receiver is either "hot" or "cold". More will be said about this

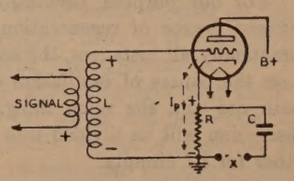


FIG. 23-4.—How degenerative effects occur when the by-pass condenser across a grid bias resistor has an open-circuit "X" either externally or internally.

later, when discussing intermittent reception. Sometimes, it is necessary to test or resolder almost every connection in the receiver in order to locate the faulty one.

An external or internal open-circuit in a grid-bias by-pass condenser can reduce the sensitivity of a receiver considerably. For example, consider the simple commonly-used "automatic bias" arrangement shown in Fig. 23-4. When a signal is applied to the tuning coil primary, an alternating voltage is induced in the secondary, L. The amplitude of this voltage is less than that of the grid bias. However, this alternating signal voltage causes the potential of the grid of the tube to become alternately more and less negative once every cycle. When the grid becomes *less negative* due to the signal, the plate current increases; and, since this plate current flows through the resistor R, furnishing the bias, the voltage drop across R would increase if C were not present (or if C had an internal open-circuit) thus tending to cause the grid bias and potential of the grid to become *more negative*. The reverse action takes place when the signal polarity is such as to tend to make the grid *more* negative. It is evident that the polarities of these changes in the bias voltage are such as to buck the signal voltage variations across L. This results in decreased signal voltage variations at the grid of the tube, with consequent loss of sensitivity. *It is the purpose of by-pass condenser C to maintain sufficient electrical charge so that the voltage across R remains constant during the individual cycles of signal voltage.* If C becomes open-circuited, then the voltage across R fluctuates a half cycle out of phase with the signal and results in what is sometimes called *degeneration*.

It is interesting to note at this time that a push-pull amplifier requires no by-pass condenser across its bias resistor, because the plate currents of both tubes are always a half cycle out of phase with each other—one decreases by the same amount and at the same time that the other increases, hence the net fluctuating current through their bias resistor is always zero. Consequently no by-pass condenser is necessary to steady the voltage across it—it is already steady.

23-8. Oscillation in Receivers.—In Chapter XV we described oscillation as the transference of energy from one electrode to another, such as from a plate to a grid. If the transfer of energy is not sufficient to maintain the circulation of energy without external aid, then the tube is said to be *regenerating*. A regenerating receiver is evidenced by extreme sensitivity and instability. High sensitivity is desirable in many cases, but, when it is beyond the point originally set by the designer, tube noises become large, the quality is impaired because of the cutting off of side bands, and the receiver becomes unstable. Instability means that the receiver will not have uniform response over the entire tuning range. Signals nearest the frequency where regeneration is greatest will have more strength than others; the signal strength of stations, especially weak ones, will vary from time to time; the dial setting for a given station will not be the same at all times; the tuning circuits will not stay aligned, because regeneration changes the effective inductance of the tuned circuits, and the change in inductance is dependent upon the amount of regeneration.

For our purpose, oscillation may be considered as an advanced degree of regeneration, and the causes of both are, in practically all instances, the same. For this reason, we will discuss the causes of oscillation and regeneration as if they were both one and the same thing. For further simplification, the discussion will be divided into two sections, one for r-f and the other for i-f circuits.

23-9. Obscure Causes of Oscillation in R-F Circuits.—Oscillation in a t-r-f receiver may be recognized instantly by the audio-frequency beat notes set up between the signals tuned in and the oscillations in the receiver. Thus, if a 1,000 kc station is tuned-in, and the receiver is oscillating at a frequency of 1,001 kc, a 1,000-*cycle* note will be heard in the loud speaker. This 1,000-cycle note will usually overlap the modulation of the original signal so that intelligent interpretation of the original audio modulation is impossible. Oscillation of this form may be verified by turning the tuning dial slowly. As a station is approached, the beat note will decrease in pitch to nearly zero, and then, as the tuning dial is turned further, the note will gradually rise in pitch until it is beyond audibility or the station is tuned out completely.

This test is an important one, for the mere presence of an audible note is not always an indication of an oscillating receiver. If the carrier waves of two powerful transmitters are but 5 kc apart, and each is modulating up to 5,000 cycles, then there will be interference between the two modulations. It is true that the carrier frequencies of local stations are separated by at least 10 kc, but a low-powered local and a high-powered distant station may be separated by only 5 kc, in which case both will be received with audible strength and interference will result. Turning the tuning dial will not produce a changing-pitch beat note here, for now the beat-note frequency is determined by the frequency separation of the two stations, not by the receiver adjustment.

Oscillation originating in a t-r-f receiver may also be detected by placing a finger *lightly* on the control-grid terminal of each of the r-f amplifier tubes. At one of them the beat note will stop, and the audio will come through clearly. This is almost always a certain indication of oscillation in the receiver, and in the stage corresponding to the tube on which the finger was placed.

The removal of the antenna lead will often make a receiver oscillate. The antenna places a certain load on the first r-f stage of a receiver, just as a resistor across the secondary of a transformer places a certain load on that transformer. If the load is too small, the tube will break into oscillation for the following reason: every stage in every receiver has a certain amount of regeneration, regardless of how small it may be. In most instances, the amount of regeneration is not great enough to cause the receiver to oscillate or become unstable. However, we know from our study of oscillator action (Art. 15-7) that when the energy fed back from the plate to the grid circuit is great enough to supply the losses in the grid circuit, oscillations will be sustained. This means that if the antenna system is removed from the input terminals of the receiver, the losses attributed to that stage are reduced, and the tube may generate self-sustained oscillations.

A receiver may oscillate if the aerial to which it is connected is too small. The remedy here, of course, is to make it longer. An excellent test for oscillation due to insufficient aerial length is to tune in a strong local station that can still be received if the aerial is disconnected. This station must also be such that a beat note is produced when it is being received with the aerial connected normally. Now, short-circuit the aerial and ground posts of the receiver and note if the beat note is still produced. If it has disappeared, then the aerial length must be increased.

Another test is to lightly tap the control-grid of the first r-f tube. If oscillations exist, a *distinct* "click" will be heard every time the finger is touched to and is removed from the cap. With the aerial-ground posts short-circuited, the clicking should disappear if the aerial needs lengthening.

23-10. Oscillation Due to Inter-Stage Coupling in Plate Circuits.—Open-circuited by-pass condensers in the plate or screen-grid circuits are one of the most frequent causes of oscillation in receivers. A typical example of such plate-circuit by-passing is illustrated in Fig. 23-5. By-pass condensers C_1, C_2 and C_3 by-pass the plate circuits; and chokes L_1, L_2 and L_3 are in the plate circuits. Suppose C_2 were to open-circuit. The *B+ Line*, carrying all the currents for the plates of the other r-f or i-f tubes, would be at a different r-f or i-f potential than the bottom of the primary P_2. Now current flows whenever there is a difference of potential, so, if the choke L_2 is not large enough to prevent the flow of r-f current, some of the weak r-f current in the *B+ Line* will flow through P_2. Hence, the plate circuit of V_2 will have r-f or i-f that belongs to some other stage. This circulation of energy between one stage and another gives rise to what is called *inter-stage coupling* (another name for oscillations generated because of the transfer of energy from one

stage to another instead of from one electrode of one tube to another electrode of the same tube).

The purpose of the condenser C_3 is to by-pass any r-f in the plate circuit to ground. In other words, the reactance of C_3 must be small enough to pass all the r-f currents through the circuit shown by the arrow. By so by-passing, the potential of the bottom of P_3 is made the same as that of *B+ Line*; hence removing the difference of r-f or i-f potential, which was causing the transfer of energy from this stage to another.

Another way of looking at the problem is to think of C_3 as

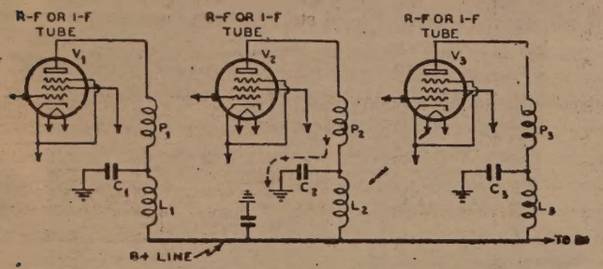


FIG. 23-5.—A typical arrangement for by-passing the plate circuits of a receiver. Chokes are shown inserted in the plate circuits to assist the by-passing action of the by-pass condensers.

having a small enough reactance to by-pass any r-f in the plate circuit of V_3 directly to ground before it gets to the *B+ Line*, and the purpose of the chokes is to assist the by-pass condenser by making the reactance of the path to this *B+ Line* great enough so that the current will flow through the easier path through C_3 to ground instead. In this manner, the *B+ Line* will have little or no r-f or i-f current flowing in it.

If any of the plate circuit chokes become open-circuited, then there will be no plate voltage on that tube in which the open-circuited choke is connected. On the other hand, if the choke becomes short-circuited, there will be plate voltage, but the receiver may oscillate because the reactance of the choke is not present to prevent high-frequency current from staying in the circuit in which it belongs—the reactance of the by-pass condensers may not be low enough to by-pass all the high-frequency currents to ground.

To sum the whole thing up in a general statement, it is good practice to employ proper by-passing and choking in order to keep all high-frequency current within the stage in which it belongs. Anything that prevents this localization of current will tend to cause oscillation. The chokes and by-pass condensers are used for this purpose—they prevent inter-stage coupling, and hence are called *de-coupling filters*. The chokes may be replaced by resistors with no change in action, with perhaps the added advantage that the impedance from P_3 to the *B+ Line* is independent of frequency; a disadvantage, however, is that the plate voltage is reduced by the voltage drop in the resistor.

23-11. Oscillation Due to Inter-Stage Coupling in Screen-Grid Circuits.—The problems arising in screen-grid circuits are somewhat different. Consider the circuit of Fig. 23-6. The *B+* voltage is fed to all the screen grids through the voltage-dropping resistor R. Each screen circuit is equipped with a separate by-pass condenser used to pass to ground any r-f or i-f in the screen circuit. It is generally conceded that choking is not needed in screen circuits. If the screen by-pass condensers are of insufficient size or are open-circuited, then it is possible for inter-stage coupling to take place because of the presence of the common voltage-dropping resistor R.

The high-frequency screen currents in the successive tubes of the amplifier are 180 electrical degrees (a half cycle). out of phase with each other, i.e., when the screen current of V_1 is *rising*, that of V_2 is *falling* and that of V_3 is *rising*. This phase shift is due to the reversal of phase in the coupling devices between the tubes. Now suppose that there were no screen by-pass condensers at all, or that they were too small or open-circuited.

An increase in screen current due to V_1 would cause an increase in the voltage drop across R. This would reduce the

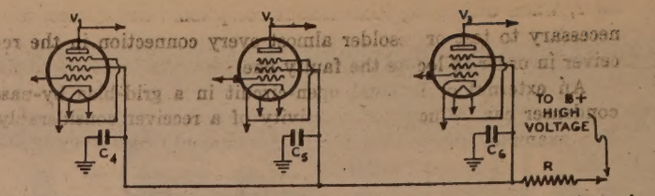


FIG. 23-6.—How several screen-grid circuits which are fed through a common voltage-dropping resistor R must be by-passed by condensers to prevent oscillation due to inter-stage coupling.

screen voltage on V_2, causing a drop in the screen current of V_2. But the drop in screen current in V_2 is greater than the increase in screen current in V_1 because the signal voltage on V_2 is greater than that on V_1 by the amplification of the preceding stage. Without considering V_3, then, the net result is a *decrease* in the current through R, which means increased voltage applied to the screen of V_1. Increased voltage on the screen of V_1 means more screen current, and more screen current means more voltage drop in R. More voltage drop in R means less voltage on the screen of V_2, etc.

This process continues to build up, with the result that the fluctuating screen currents reach proportions entirely unwarranted by circuit conditions, and, if these fluctuating currents are not by-passed to ground, oscillation due to inter-stage coupling is sure to result. On the other hand, the phase of the screen current in V_3 is the same as that in V_1, so that any increase in screen current in V_1 will lower the screen voltage on V_3. And since the screen current in V_3 is in the process of increasing, in phase with V_1, the net result is a smaller variation in current than is warranted by circuit conditions, and inter-stage coupling is minimized.

Of course, the same thing happens if the plate circuits are fed by a common resistor which drops the higher B voltage to the proper value required for the plates of the tubes. In this case, a large condenser, about 4 mfd., must be connected to the plate side of the common resistor. This condenser, having a large capacity, will maintain the voltage applied to the plates constant during high-frequency changes, preventing the cumu-

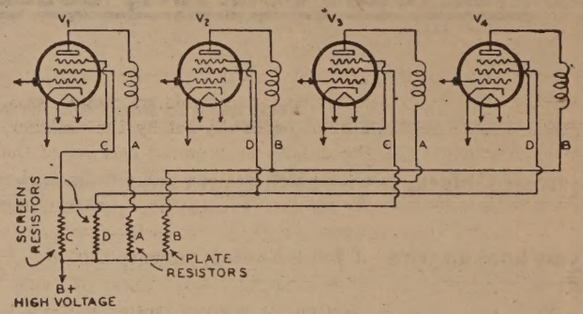


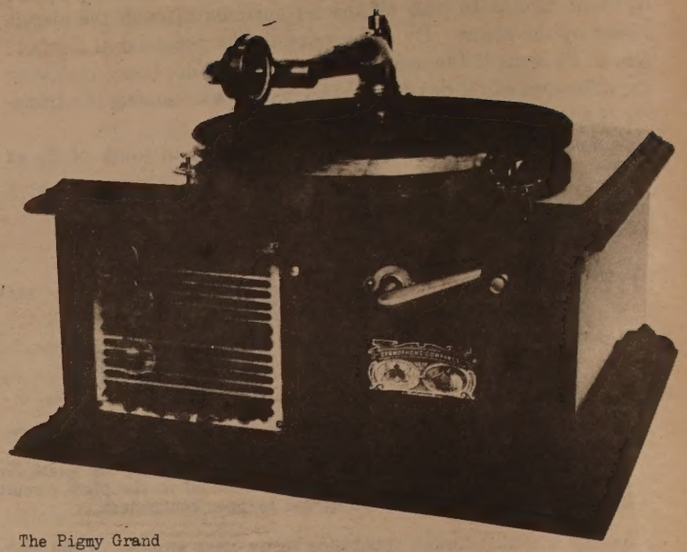
FIG. 23-7.—An amplifier circuit arrangement in which the connecting together of the screen grids and plates of the alternate tubes prevents inter-stage screen- or plate-circuit coupling without the need for by-pass condensers or chokes.

lative action described. The action of each of the by-pass condensers shown in Fig. 23-6 serves the same purpose, so that if one of them becomes open-circuited, there is a possibility of oscillation, or at least regeneration, taking place.

This discussion leads to the interesting fact that since the r-f or i-f current variations in the screen and plate circuits of successive amplifier tubes are a half cycle out of phase, the plate circuits of *alternate tubes* may be connected through a common resistor without by-passing of the resistor or use of plate circuit chokes (as shown in Fig. 23-7) without danger of oscillation. The same is true for the screen-grid circuits, as shown. This circuit arrangement, which is shown here for the "plate" as well as for the "screen" circuits is used in many commercial receivers.

To be continued

The Hymnophon



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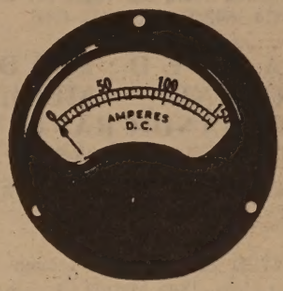

WANTED: WESTON 431 METER, 0-200 mH KS-6184, aircraft instruments, meter booksand catalogs. Chris Cross, Box 94, McConnell, IL 61050.

WANTED: INFO ON LIBERTY BELL aerial made by U.M.B. Co. Mpls., MN (photo, description, ad copy, etc.) Need Philco 118, 144, 507L or 506L chassis, speaker and/or escutcheon, any condition but complete. E. H. Scott AW23 power chassis and/or speaker, any condition, -- Dave gonshor, 7121 S.Jellison St., Littleton, CO 80123. (303) 979-9511.emaildavid.v.gonshor@den.mmc.com

WANTED: HOME BREW CRYSTAL SETS, detectors, Baldwin C headphones, wholesale source for headphones cords, --- Turke, P. O. Box 2288, Hollywood, FL 33022.

Wanted: FELIX the CAT items. Radios, records, books, toys comics, pinbacks, comic books, etc. If you have anything with Felix on it (for sale or not) please contact me. I am compiling a list of all Felix the Cat memoribilia ever made. D Smith, box 770813, Lakewood, OH, 44107. hz179@cleveland.Freenet.Edu

WANTED: NEED WESTON 431 METER, 0-200 mA KS-6184. I collect meters of any type, and would like to find any books or catalogs showing lots of photos of meters. Also want histories of old meter manufacturers: Jewell, General Electric, Westinghouse, Marion, etc. Looking for books detailing the use of meters in locomotives, large ships, trucks and tractors, milling and mining industries, etc. Also want anything from or about 1940's aircraft: flight instruments, log books, manuals, etc. -- Chris Cross, Box 94, McConnell, IL 61050.

WANTED: GLASS DIAL scale for Philco, model 41-608, part #27-?637, 50mm x 220mm. glass dial scale, Stewart Warner, #502505, used in models 9014E,62T36 and possibly others. Joe Vittitow, 1341 Harrodsburg Road, Lawrenceburg, KY 40342. Call collect (502) 839-5444.

WANTED - "B" battery eliminator 45/90/135 VDC. Prefer Freshman unit or equivalent for Freshman Masterpiece radio. Also, wood speaker grill for same. --- Dick Roznovsky, 216-321-4309 or write -- P. O. Box 480, Richfield, OH 44286

ADD: Wanted ocilator coil for GE model C416-A, Approximatel 3/4" dia.1-1/4" high, 5 pin. dalfonso@e-tex.com

Wanted: CHASSIS for Kennedy VI, Kennedy 281, DeForest F5, and two white tuning dials for a Radiocraft Interpanel. PH.# (303) 979-0331.

WANTED: OLDER TELEGRAPH ITEMS and oddball electricals, mechanicals andscientifics. --- Jos. Jacobs, 60 Seaview Terrace, Northport, NY 11768. (516) 261-1576.

WANTED: TUBE HI-FI, tube commercial amps. speakers and horns. Altec, Marantz, Jensen, RCA, Dynaco, Heath, EICO, Scott, Fisher, McIntosh, Pultec, JBL, Electrovoice, Craftsman and Tannoy. Some old guitar amps. also Fender, Gibson, Vox, Vallo, Supro, Magnatone, etc. — Sonny Goldson, 1413 Magnolia Lane, Midwest City, OK 73110. Call (405) 737-3312.

GREBE

WANTED: GOOD BINOCULAR COILS for a Grebe Synchrophase or parts radio with good coils: --- Charles R. Combs, 508 E. Daniel, Albany, MO 64402. (816) 726-3038.

GRIMES

WANTED: David Grimes radios models: M3XP and 4DL -- Mike Grimes, 3805 Appomattox Circle, Plano, Texas 75023. (214) 867-6373.

Subscribers to *The Horn Speaker* get first "crack" at the classified ads.

HALLICRAFTERS

WANTED: COPY OF SCHEMATIC and original tyupewritten material supplied with the 1936-37 SX-9, Leland smith, 10 Hawthorn Drive, Harrison, AR 72601.

Wanted:Case and Dustcovers for Hallicrafters S-27 Ultra High Frequency Receiver.email: dave@flowserver.stem.comvoice: (415) 813-5028

WANTED -- S meter and cover for Hallicrafters SX-17. Thank you. -- Vern Snyder, 5 Parkview Drive, Winder, GA 30680. -- Telephone (770) 307-1459.

INFO WANTED

I am a researcher looking for family and/or Memorial Research Foundation of Edwin Howard Armstrong. I work for Actuality Productions who produces a series for the History Channel called "Modern Marvels". Our current episode will be entirely devoted to the history of Radio. We all feel that Armstrong's story must be told. RnoelB@aol.com

I have a 1947 shortwave Hallicrafter. Need to have the speaker repaired. Does anyone have any information? Eliezer Parillaatron@inch.com

Need info : Buckwalter Radio (Supertone Radio Co.) Pyle-Amplex Radio --- Wayne Gilbert, 10751 Routt St., Broomfield Co. 80021, 303-465-0883Wagil@aol.com Will pay calls, costs.

HEADPHONES

WANTED: OLD HEADPHONES, -- any amount. Phone plugs, parts also -- Please send list or call. -- Dick Mackiewicz, 1549 N. River Road, Coventry, CT 06238: (203) 742-8552.

LITERATURE

FOR SALE: 52 popular electronic magazines, dates 1972-1982, all $18.00 plus shipping, phone or write, (601) 922-2235 --- Thomas Burnside, 4838 South Westhaven Drive, Jackson, MS 39209-4711.

WANTED: ORIGINAL MANUAL for Collins 32V-3 xmtr. --- Barney Wooters, W5KSO, 8303 E. Mansfield Avenue, Denver, CO 80237. (303) 770-5314.

Rider Manuals Volume 19 and 21, Robert Haas, 2846 Marida Court, Las Vegas, NV 89120. Phone (702) 434-3642, fax (702) 434-4966.

WANTED: MODERN MECHANIX, MECHANICS AND HANDICRAFT MAGAZINES -- Ken Ladd, 5240 44th Aves., Mpls., MN 55417 (612) 722-6786.

WANTED: Rider Manuals volumne 19 and 21. Herbert Haas, 2846 Marida Ct., Las Vegas, NV 89120. Phone (702) 434-3642, fax (702) 434-4966.

MISCELLANEOUS

INTERESTED in used radio and computer equipment. Please call (512)452-5307. Val Brown.

MOTOROLA

I am looking for a MOTOROLA pre-war radio. Must have wooden cabinet, must have some shortwave. Prefer working condition, but not required.Please send e-mail to hbr@ix.netcom.com, or call 954-741-0870.

PARTS

My brother-in-law has an old westinghouse stero?, from back in the 1940's. He's looking for a needle for the recordplayer and this is the # he gave me H-169. He's looking for a place to purchase this needle. If you could be of any assistance He and I would greatly appreciate it. LENNYT@prodigy.net

WANTED: IF TRANSFORMER for Philco model 84 -- junker chassis for International (Kadette) model ES-25, model 60 or 85 --- Harold Wright, R.R. 1 Box 239, Chancellor, AL 36316-9749. (334) 347-0393.

WANTED: CRYSTAL HEADPHONES, varible condensers, variocouplers, detectors, wire, terminals, points. — Turke, P. O. Box 2288, Hollywood, FL 33022.

WANTED: For GREBE SYNCROPHASE MU-1, 2 dial escutcheons large diamond, lables --- Steve Morton, 905 West First, North Platte, NE 69101 (308) 534-4778.

WANTED: A SET OF FOUR WOOD KNOBS FOR AN ATWATER KENT MODEL 206; KENNETH MILLER, 10027 CALVIN STREET, PITTSBURGH, PA 15235. (412) 242-4701.

PHONOGRAPH

OWNERS OF AUTOMATIC RECORD CHANGERS. Being a lazy audiophile, I play my vinyl on an automatic record changer (Dual 1229). I would like to serve as the anchor to form a network of others doing the same for the purpose of exchanging repair tips, parts sources, making trades, etc. If youare the user/owner of a Dual, Garrard, B.I.C. or other hi-end changer, please contact me.Larry Chandler, (407) 344-0777, e-mail: box1@webtv.netThanks,

Wanted: Original reproducers for Busy Bee Grand phonograph and Columbia model B "Eagle". Also, any information regarding Deutsche Grammophon machine that resembles the E. Johnson Victor model C. The machine needs reproducer, elbow, crank, and governor gear and/or mating turntable gear. e-mail ssmith@ionet.net or contact Scott Smith P.O. 335, Owasso OK74055

Wanted: source of repair for broken wind-up spring in RCA vv-470. R. Morrison. 1597 Maquinna Ave. Comox,B.C. Canada. V9M 3L2. (rmorris@mars.ark.com)

NEED INFO on IX Victrola, Jim Knapp, (409) 860-0312.

Wanted: OLD CRANK PHONOGRAPHS. incomplete machines, parts, horns, Nipper items, needle tins and any related items. -- Dave Faehnrich, 8215 Stone Road, Independence, OH 44131. (216) 447-0837.

PHILCO

WANTED: GOOD CABINET OR PARTS SET for 1941 Philco console 42-1012 or 42-1013. These were AM, old FM and phonograph units. -- Charles

A reminder .... classified ads can be placed in *The Horn Speaker* as late as the 27th day of the preceding month. Thank you, again

R. Combs, 508 E. Daniel, Albany, MO 64402. (816) 726-3038.

QSL CARDS

Wanted -- PRE-1950 U.S. OR FOREIGN QSL cards in good condition. Ship withyour price or request my cash offer. -- Marc Madow, 4720 Vineland Avenue, North Hollywood, CA 91602.

RADIO EQUIPMENT

SEEKING USED RADIO EQUIPMENT for small radio station, contact: Valerie@bga.com;(512) 452-5307 http://www.bga.com/~valerie -- Valerie Atkinson, 13 Sunrise Acres, Kyle, TX 78640.

SCOTT

WANTED: I NEED THREE OF THE CHROME circular 3 1/2" transformer covers like used on a Scott All Wave 23 chassis. A parts chassis would be considered. -- Charles R. Combs, 508 E. Daniel, Albany, MO 64402.(816) 726-3038.

SENCORE

HELP- WANTED -- SENCORE FE14 or FE16 field effect meter, for parts. Phone (210) 464-8034 -- Ken flockhart, Big Valley Tr Park #58, 109 US Bus Hwy 83-W, Donna, TX 78537-2499.

TEST EQUIPMENT

Want: SIGNAL GENERATOR for sweep alignment of standard broadcast sets, working or restorable. Call collect (501) 839-5444. -- Joe Vittitow, 1341 Harrodsburg Road, Lawrenceburg, KY 40342.

WANTED HICKOK 209A VACUUM TUBE VOLTMETER OR OTHER HICKOK VTVM CONTACT MIKE PISKUNOFF 216-777-3498 E-MAIL jukebox1@ix.netcom.com

TUBES

WANTED: GOOD WORKING TRANSMITTING and special purpose tubes: 468, 285, WL469, 822, 203A, 211, VT4C, 311 and 835. Goldman, 3 Amy Lane, Queensbury, NY 12804.

WANTED: WARDS SUPER AIRLINE TUBES that check good. Looking for three each of white based AX-201A and gold colored glass GX-201A. -- Charles R. Combs, 508 E. Daniel, Albany, MO 64402. (816) 726-3038.

ZENITH

Wanted: Zenith Transoceanic radios models 520/URR, 520A/URR and R-7000. Top prices paid for nice examples. Contact Robert McPherson by e-mail or call (505)-522-3841.

WANTED FOR ZENITH 10S153- tuning shaft assembly, tube shields, plate choke Zenith #20-135, tuning knob, chassis mounting bolts and springs. Willing to pay fair price for these items, Willard Smith, 1802 13th St., Bedford, IN 47421. Call eves. (812) 275-5760.

Wanted Zenith Transoceanic A-600 or B-600. Must be in excellent operating condition at all bands and absolute mint condition cosmetically. The log book and instruction books must be original and present.- The radio should have leather case and must be in excellent cosmetic condition.Email: ektpuah@pacific.net.sg or ektpuah@newspage.com.sg

WANTED: GOOD CABINET for Zenith model 12 battery radio or non-working radio for parts. -- Charles R. Combs, 508 E. Daniel, Albany, MO 64402. (816) 726-3038.

WANTED: ZENITH 1942 TRANS-OCEANIC CLIPPER with sailboat or bomber grill, 7G605. Nice looking working radio, preferred but all considered. -- Charles R. Combs, 508 E. Daniel, Albany, MO 64402. (816) 726-3038.

WANTED: ZENITH R-7000-Z with the 2WMR70 chassis from the late 1970's and early 1980's. A nice clean working radio is desired. -- Charles R. Combs, 508 E. Daniel, Albany, MO 64402. (816) 726-3038.

WANTED TO BUY, A 'MINT', 'near-mint', Zenith Transoceanic Royal D7000Y This is the one with the tunable weather band. Would also be interested in valved models.73, N8JDG Chris Kaineckaine@one.net

I'm looking for the 2 frequency tuning knobs for a Zenith 12-A-58. Cntactme (John) at bth0jch@bth20.med.navy.mil. I am looking for Mint or Near Mint Zenith Trans Oceanics. All models. Please Email me with ACCURATE description/pricing/shipping info. I ama ready, willingand able buyer. Thanks, Barry Gluck -- bgluck@monmouth.com

WANTED: For Zenith model 52 0r 53, complete chassis with "automatic tuner," ZE-50 60hz. power supply, speaker knobs. Charles A. Days, P. O. Box 80205, S. Dartmouth, MA 02748-0205. (508) 979-3758.

Advertise in *The Horn Speaker*

E-mail cranshaw@e-tex.com
The Horn Speaker, P. O. Box 1193, Mabank, TX 75147

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street address_____

city _____ **state** ___ **zip** _____

telephone number _____

Card number _____ Exp. date _____ Name as

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